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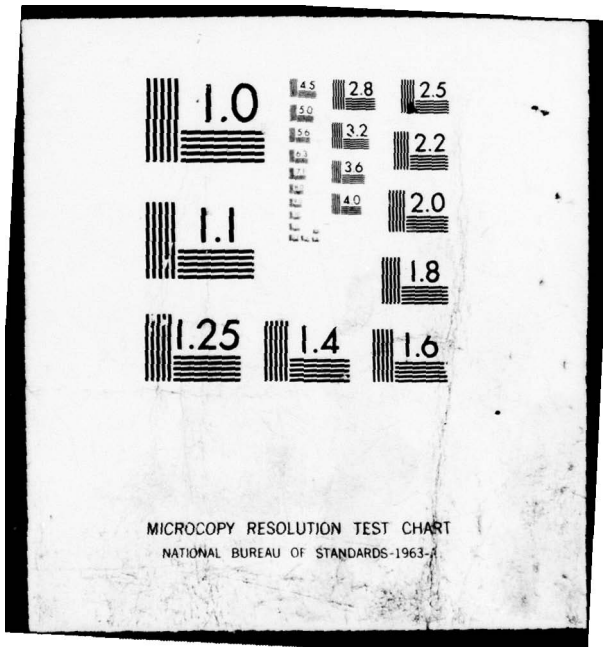
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(6) National Dam Safety Program. Pinchot Lake Dam (Inventory Number NDS 335), Susquehanna River Basin, Beaver Creek, York County, Pennsylvania. Phase I Inspection Report.

LEVEL II (1) NW

SUSQUEHANNA RIVER BASIN

PINCHOT LAKE DAM

COMMONWEALTH OF PENNSYLVANIA

YORK COUNTY

(11) 23 May 78

INVENTORY NUMBER NDS 335

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

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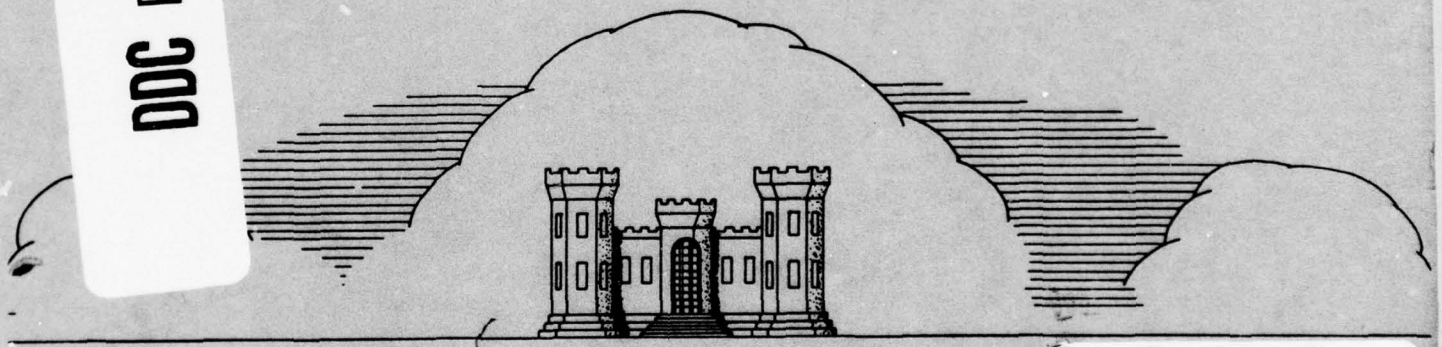

Prepared For
DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland
by
BERGER ASSOCIATES, INC.
CONSULTING ENGINEERS
HARRISBURG, PA.

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PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam: PINCHOT LAKE DAM

State Located: PENNSYLVANIA

County Located: YORK

Stream: BEAVER CREEK

Date of Inspection: April 12, 1978

Based on a visual inspection, past performance and available engineering data, the dam and its appurtenances appear to be in good condition. The following recommendation is made:

1. The sluice gate operation should be improved for emergency use.

The spillway capacity is not sufficient to pass the Probable Maximum Flood (PMF) without overtopping the dam. In accordance with the guidelines the recommended spillway design flood for this location is one-half PMF and the spillway will pass this discharge. The spillway is, therefore, considered to be adequate.

In the event of unusually heavy precipitation, an around-the-clock surveillance plan should be implemented and a formal downstream warning plan should be established.

Submitted By:

BERGER ASSOCIATES, INC.
HARRISBURG, PA.

Date: May 23, 1978

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL ENGINEER
HENDRIK JONGSMA
No. 5557E

Approved by:

G. K. WITHERS
Colonel, Corps of Engineers
District Engineer

DATE: 30 May 1978

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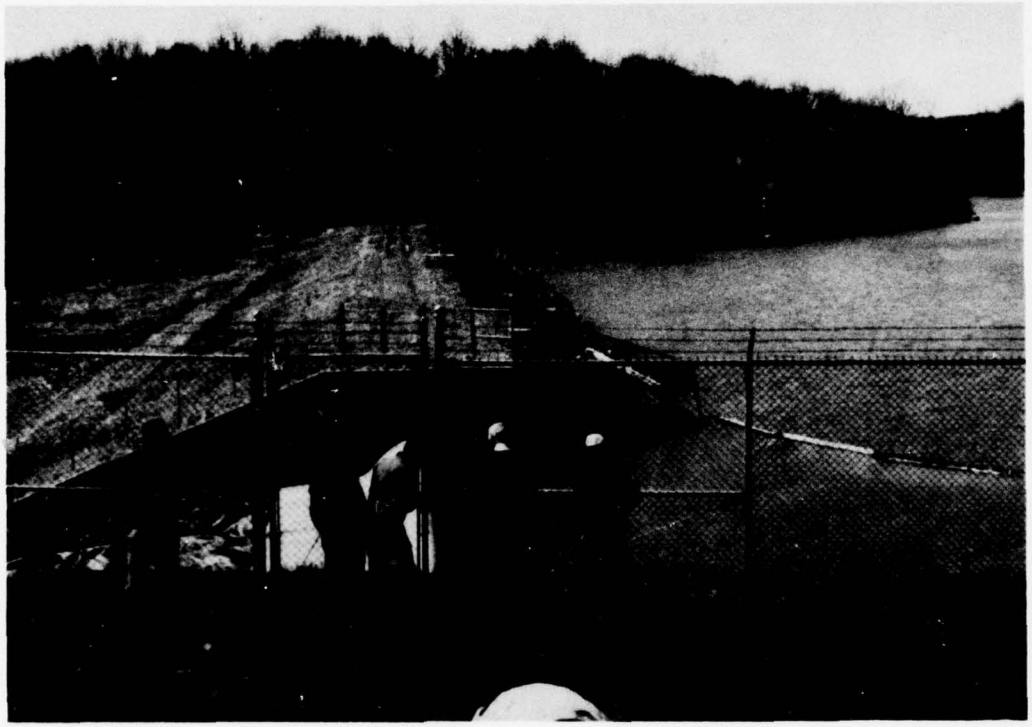


OVERVIEW

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority

The Dam Inspection Act, Public Law 92-367 (Appendix III) authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspections of dams throughout the United States. Phase I Inspection and Report is limited to a review of available data, a visual inspection of the dam site and the basic calculations for determining the hydraulic adequacy of the spillway.

b. Purpose

The purpose is to determine if the dam constitutes a hazard to human life and property.

1.2 DESCRIPTION OF PROJECT

a. Dam and Appurtenances

Pinchot Lake Dam is a rolled earthfill embankment with an impervious core and rockfill protection (Appendix D, Plate IX). The embankment length is approximately 626 feet and has a maximum height of 50 feet. Outlet works consist of a 368 foot long, 3 foot diameter concrete pipe with a valve chamber and control tower located on the upstream side of the dam axis, and a impact type energy dissipator on the downstream side.

The spillway is located on the left abutment and has an uncontrolled ogee weir with a low flow notch. The spillway chute is cut out of the natural rock formation and has a concrete wall on the right side and a concrete stilling basin at the end. See Appendix D for photographs and general plan.

b. Location: Warrington Township, York County
U.S. Quadrangle, Dover, Pa.
Latitude 40°05.3, Longitude 76°52.3
(Appendix D, Plates I and II)

c. Size Classification: Intermediate (Height 50 feet, 8,000 acre-feet)

d. Hazard Classification: Significant (See Section 3.1.e)

e. Owner: Commonwealth of Pennsylvania
Department of Environmental Resources
P. O. Box 1467
Harrisburg, Pa.

f. Purpose: Boating, Fishing and Swimming

g. Design and Construction History

The dam was designed for the owner by Buchart Engineering Corporation, York, Pa. The Contractor was Hempt Brothers, Harrisburg, Pennsylvania, and construction was completed in October, 1959. In 1973 the pool level was temporarily lowered and repairs were made in the spillway. This damage occurred during the Agnes storm of June, 1972.

h. Normal Operation Procedure

Normal operations attempt to maintain the pool level at the elevation of the notch in the spillway (Elevation 470.0). A pool elevation of two feet more (ogee elevation 472.0) causes considerable flooding and sedimentation on the four beaches along the lake. Due to the narrowness of the notch, there is considerable fluctuation in the pool level. To assist in maintaining the pool level at 470.0, the gate in the outlet conduit is adjusted quite frequently.

1.3 PERTINENT DATA

a. Drainage Area (square miles)	17.5
b. Discharge at Dam Site (cubic feet per second) See Appendix B for hydraulic calculations	
Maximum known flood at dam site Occurred June 22, 1972 Pool elevation - 476.4	6,320
Warm water outlet. The only warm water outlet is the uncontrolled flow over the spillway.	
Outlet tunnel at pool elevation 436.0	72
Outlet tunnel outlet at pool elevation 470.0	170
Spillway capacity at pool elevation 477.1 **(design surcharge). The design outflow** was 7,600 cfs. Calculations for this report give	8,700

Spillway capacity at pool elevation 481 (top of dam)	20,000

c. Elevation (feet above mean sea level)

Top of dam	481.0
Maximum pool - design surcharge	477.1
Full flood control pool	472.0

The full length of the spillway weir is 180 feet. Of this amount, 30 feet on the left end is a notch with a crest elevation two feet lower than the main part of the weir. Since the notch has a relatively small discharge capacity, the last two feet of surcharge drains out slowly and a certain degree of flood storage is provided.

Recreation pool	470.0
Spillway crest	
30 foot long notch at left end	470.0
Remaining 150 feet of length	472.0
Upstream portal invert of outlet tunnel	433.0
Downstream portal invert of outlet tunnel	427.0
Streambed at centerline of dam	432
Maximum tailwater estimate	439

d. Reservoir (feet)

Length of maximum pool (Elev. 481.0)	20,000
Length of recreation pool (Elev. 470.0)	17,000
Length of flood control pool (Elev. 472.0)	18,000

e. Storage (acre-feet)

Recreation pool (Elev. 470.0)	2,800
Flood - control pool (Elev. 472.0)	3,570

Design surcharge (Elev. 477.1)	5,880
Top of dam (Elev. 481.0)	8,000

f. Reservoir Surface Area (acres)

Top of dam (Elev. 481.0)	625
Maximum pool (Elev. 477.1)	510
Flood control pool (Elev. 472.0)	387
Recreation pool (Elev. 470.0)	342
Spillway crest	
150 feet at Elev. 472.0	387
30 feet at Elev. 470.0	342

g. Dam

Type: Rolled earthfill embankment with impervious core.

Length: 626 Feet.

Height: 50 feet Maximum

Top Width: 20 feet

Breast Elevation: 481.0

Sideslopes: Upstream 3H to 1V - Rockfill
Downstream 2.5H to 1V - 10 feet wide berm at elevation 462.0

Cutoff Trench: Bottom width of 20 feet excavated to top rock surface. Sideslopes 1H to 1V.

Grout Curtain: 1-1/2 inch holes were drilled at approximately 7.5 foot centers with depth varying from 20 to 50 feet.

Filters: The upstream slope of the impervious core is 1.5H to 1V and is protected by a two foot deep mixed filter and rockfill. The downstream slope of the impervious core is daylighted. The toe is of rockfill material and separated by a two stage filter from the impervious material.

h. Outlet Conduit

Type: 36 inch inside diameter concrete pipe.

Length: 368 feet.

Entrance: Invert elevation 433.0 with headwall and apron and trash rack protection.

Outlet: Elevation 427.0 with a 13 foot wide and 21.17 foot long impact-type energy dissipator.

Regulating Facility: Valve chamber tower located 15 feet upstream from the dam centerline, with manually operated sluice gate. The tower is a six-foot diameter concrete structure. Discharge capacity at pool elev. 470 - 170 cfs.

i. Spillway

Type: Uncontrolled ogee section at two elevations.

Length: 180 feet, including a 30 foot length of notched section. Maximum discharge capacity 20,000 cfs.

Weir Elevation: 472.0 with the notched section at Elev. 470.0.

Upstream Channel: Excavated to elevation 467.0 with vertical rock cut on left side.

Spillway Chute: Excavated into rock, narrowing from 180 feet to 50 feet at stilling basin. Slope along centerline is 13.37% with a very rough surface.

Stilling Basin: Reinforced concrete bucket 103 feet long by 50 feet wide with energy dissipators. A four-foot-deep bucket is formed with the end sill.

Downstream Channel: Trapezoidal with 50 foot bottom width and rip rap slopes. A new bridge is located about 700 feet downstream. The estimated capacity of bridge opening is 12,000 cfs.

j. Regulating Outlets

1. Automatic flood-control regulation is provided by means of a 2 foot by 30 foot notch at the left end of the spillway weir. This

has the effect of holding back and slowly releasing 770 acre-feet of stored flood waters.

2. The 30 inch diameter valve in the 36 inch diameter tunnel may be operated to release up to 170 cfs.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

a. Data Available

1. Hydrology and Hydraulics

A Permit Application Report was prepared by the Pennsylvania Department of Environmental Resources (PennDER) in April, 1958, on the application prepared by Buchart Engineering Corporation at the request of the Flood Control Division. This report contains no information, other than a small summary of the main features, and no hydraulic information.

The design drawings have a set of design curves, including hydrograph, drawdown curves, mass rainfall curve, area-capacity curves and a synthetic mass rainfall curve (Appendix D, Plate VIII). No other calculations were in the files.

2. Embankment

The embankment design was based on a geologic survey and a "Report on Subsurface Exploration" by Berger Associates, Inc., Harrisburg, Pennsylvania. This report includes pressure tests and borrow material explorations. A copy of this report is in the PennDER files.

3. Appurtenant Structures

Structural design assumptions and analysis were not available in the PennDER files.

b. Design Features

1. Embankment

The design drawings show that the central part of the dam is formed with impervious material separated with a filter on the upstream side of the rockfill. Most of the downstream slope is formed by the impervious material except for a large toe fill built from rockfill.

The two zones are separated by a two-stage filter. A sand filter is placed at the bottom of the rockfill. The downstream slope has been seeded.

The cutoff trench is carried down to top of rock and a grout curtain is indicated on the plans.

2. Appurtenant Structures

The foundation of the ogee section is keyed into rock. The end of the section is recessed at least 3 feet into the rock side. The individual ogee sections are keyed and have water stops.

The stilling basin walls are supported on spread footings on rock. All walls and slabs are of reinforced concrete and adequate drainage details are indicated.

The control tower is also founded on rock.

c. Design Data

1. Hydrology and Hydraulics

The design drawings contain hydrographs, area-capacity, drawdown and mass rainfall curves. No indication of spillway capacity was found in the files.

2. Embankment

The embankment design and foundation was based on a subsurface investigation report by Berger Associates, Inc. The design drawings show the borings, test pits and approximate rock surface lines (Appendix D, Plate X). No seepage calculations are indicated. The actual adopted design values are not presented.

3. Appurtenant Structures

There were no design values or design calculations available for review.

2.2 CONSTRUCTION

The Contractor was Hempt Brothers and the only construction data available was the original contract drawings. The present condition of the dam and appurtenant structures indicates that the quality of construction was good.

2.3 OPERATION

No formal records of operation are available except recording gage records of pool stage which are on file in the U.S.G.S. office in Harrisburg, Pa. The Park Superintendent has abstracts of these records. See Section 5.1.b for flood elevations from this gage. Due to the fractured rocks in the chute, the stilling basin must be cleaned periodically and the Park Superintendent indicates that this is done. The impounded lake

has been drawn down several times for park management. In 1963 and 1965 the lake was drawn down for boat dock dredging and installation of boat docks. Other drawdowns occurred in 1967 (control of aquatic growth) and in 1970 and 1971.

In 1970 a staff gage was installed near the ogee section, but this was destroyed in the past winter (1977-78). This staff gage is only for a check on the U.S.G.S. recording gage and normally no records are kept.

In 1973 damage in the spillway chute was repaired by placing concrete at the right walls.

2.4 EVALUATION

a. Availability

A full set of design detail drawings including borings are available at the Division of Dams and Encroachments, PennDER. The files include a Subsurface Investigation Report.

b. Adequacy

1. Hydrology and Hydraulics

The data available is reasonably complete (Appendix D, Plate VIII), although no frequency of design discharge was given. Spillway capacity curves were not available but the design flood pool elevation and discharge was listed.

2. Embankment

The soils report indicates that the site and borrow pits were satisfactory for the construction of a dam at this site. The detail drawings indicate that the engineering concept was adequate. Filters and toe drainage are provided.

3. Appurtenant Structures

A review of the design drawings indicate that all structures were well engineered. All walls have footings founded on rock and are of sufficient width to provide stability in accordance with acceptable engineering design criteria. The weir is keyed in rock and a grout curtain is provided. Due to accumulation of stone in the stilling basin, the energy dissipators could either be damaged during high discharges or not be effective.

c. Operating Records

The pool-stage recorder in the spillway forebay supplies a record of water elevations, and this record is available in the USGS office in Harrisburg, Pa. See Section 5.1.b for the details of the two greatest floods of record. The spillway chute experienced some scour during the Agnes storm, but the capacity was more than adequate. The notched weir does not seem to be ideal for the management of the park.

d. Post Construction Changes

The only modifications made after construction was the installation of a concrete protection for the right wall of the spillway chute. The use of a sharp transition facing upstream in these walls is not desirable (Appendis D, Plate V). However, no damage was detected.

e. Seismic Stability

This dam is located in Seismic Zone 1 and it is considered that the static stability with acceptable factors of safety is sufficient to withstand minor earthquake-induced dynamic forces. No calculations or studies have been made to confirm this conclusion.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General

The general appearance of the dam and appurtenant structures is good and indicates that the dam is well maintained. Photographs taken during the visual inspection on April 12, 1978, are reproduced in Appendix D, Plates III through VI.

b. Dam

The dam embankment is generally in good condition. Most of the area is seeded with crown vetch and is not mowed. In addition to the crown vetch some other plant and brush growth is present. Some of this growth is left in place to discourage people walking over the embankment. Mr. Harris, the Park Superintendent, stated that an annual program for removal of objectionable plant growth, such as cedars, is maintained and that the small areas on the downstream slope which require revegetation will be taken care of when weather permits. Some wet areas on the berm were caused by rainwater and will dry out according to the Park Superintendent. Some regrading should be considered.

To control the pool level, the gate is used quite regularly. The breast of the dam developed some ruts during the past winter; Mr. Harris, the Park Superintendent is planning to place a stone driveway on the breast during the summer.

There was no indication of any cracking, sloughage or settlement and the condition of the riprap is good.

c. Appurtenant Structures

1. Control Tower and Conduit

The tower appeared in good condition. The gate is operated quite regularly to prevent flooding of the beaches by keeping the pool level at elevation 470.0. The operation of the gate is difficult, probably caused by undersizing the gate hoist. The outlet of the conduit is in good condition.

2. Spillway

The spillway crest is in good condition. Some of the joints cause a maintenance problem due to loosening of the sealer. One vertical joint indicated some seepage.

The spillway channel floor and left side are unpaved bedrock. Some erosion of the fractured rock is occurring and this requires cleaning of the stilling basin at certain intervals.

The right wall is of reinforced concrete set on a rock foundation. Some deep scour occurred during heavy discharges and additional concrete protection was placed along the toe of the wall. The appearance was good and no signs of distress were noticed. The stilling basin was in good condition, except for some erosion occurring at the left side of the outlet channel.

d. Reservoir Area

The impounded lake is for swimming, boating, camping, fishing and other recreational purposes; over one million visitors used the facilities in 1977. Maintenance of the lake banks is excellent. Some siltation occurs on beaches during high water and there is a considerable amount of siltation in the upper reaches of the lake.

e. Downstream Channel

The downstream channel is clean and, except for some erosion just below the stilling basin, in good condition. A bridge over the creek is located about 700 feet downstream of the stilling basin. This restriction will increase the height of tailwater during high discharges.

No communities are located downstream on Beaver Creek, which joints the Conewago Creek about 1.5 miles downstream of the dam. Several houses are located close to the stream and the downstream area has appreciable agricultural development. The Pinchot Lake dam is, therefore, considered to be in the Significant Hazard Classification.

3.2 EVALUATION

The observed condition of this project is considered good. The minor maintenance problems discussed will be attended to during the summer months and should have no effect on the safety of the dam.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

Mr. Clarke Harris, Park Superintendent, stated that the desired pool level for this lake is at elevation 470.0, the low notch spillway elevation. Higher water causes flooding of the beaches and boat docks, lower water levels reduce the effective swim areas. Due to the relatively short notched weir section, maintaining a constant level is rather difficult and the valve on the conduit is used for additional control. The conduit is also used to maintain minimum flow during pool levels below elevation 470.0.

4.2 MAINTENANCE OF DAM

Crown vetch has been planted on the downstream embankment slope. No mowing is done, but brush and tree growth is kept under control.

4.3 MAINTENANCE OF OPERATING FACILITIES

The sluice gate is opened regularly, but the opening of the gate requires considerable force. A cheater consisting of a pipe extension on the operator wheel is used. The control tower is inspected and the bearings are being greased.

4.4 WARNING SYSTEM

There is no formal warning system in effect and no procedures are established to inspect the dam and spillway during periods of heavy precipitation. The park superintendent lives about 1.5 miles from the dam site.

4.5 EVALUATION

The operational procedures seem to be satisfactory. The following two points should be considered:

a. An inspection and warning procedure should be established for periods of high precipitation.

b. The need to use a cheater on the operation of the sluice gate should be examined. Continued use could cause failure of the equipment.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data

The hydrologic and hydraulic analysis available from PennDER was reasonably complete. Minutes of a December 2, 1957 meeting between officials of the State and Buchart Engineering Corporation indicate that the design was based on an assumption of 12 inches of runoff in a period of six hours. The above assumptions were calculated to result in a peak outflow of 7,600 cfs using a spillway 180 feet long. Peak pool elevation of 477.1 feet was indicated. No frequency was given for the above storm, except that "everybody agreed (it) was a very remote possibility".

Included in the files were: area-capacity curves, mass inflow and outflow curves, and drawdown curves (Appendix D, Plate VIII). Rating curves for the spillway and the tailwater were not included.

b. Experience Data

PennDER and USGS cooperate in the operation of a recording, pool-stage gage upstream from the dam. Records from this gage indicate the following extreme discharges as calculated in Appendix B:

Storm	Date	Elevation (feet)	Calculated Discharge (cfs)
Eloise	9/26/75	475.37	4,800
Agnes	6/22/72	476.04	6,400

There is no tailwater gage but the Park Superintendent reports that the 1975 flood came within about 18 inches of the underside of the highway bridge, which is 700 feet downstream from the dam.

c. Visual Observations

On the date of the inspection, no conditions were observed that would indicate that the appurtenant structures of the dam could not operate satisfactorily during a flood event until the dam is overtopped.

During past floods, pieces of rock have been torn loose from the unlined spillway chute and have filled up the stilling basin. Apparently this has lessened the effectiveness of the stilling basin and resulted in some erosion of the stream bank downstream from the dam. This erosion has been repaired with riprap.

d. Overtopping Potential

The dam is an intermediate sized dam in the Hazard Category of "Significant". The recommended Spillway Design Flood (SDF) this classification is between one-half PMF (Probable Maximum Flood) and PMF. Calculations in Appendix B indicate that the PMF for this dam is 35,000 cfs. The estimated spillway capacity is 20,000 cfs and the required storage capacity to handle an inflow of 35,000 cfs would be 20,760 acre-feet (Page 3 and 4, Appendix B). The available storage capacity is 5,200 acre-feet and, therefore, the potential for overtopping the dam does exist. However, the dam can pass one-half PMF without overtopping.

e. Spillway Adequacy

The spillway capacity for Pinchot Lake Dam is 20,100 cfs, which is 57 percent of PMF and is, therefore, inadequate. The spillway will, however, pass one-half of PMF and the spillway capacity is not judged to be seriously inadequate.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observation

1. Embankment

Visual observations indicated there were no of undue embankment stresses which would be indicated by sloughage, cracking or seepage. A few bare spots on the downstream slope will be seeded and there is a maintenance program to eliminate the wood chuck holes. Wet areas on the berm are caused by poor drainage after a rain shower.

2. Appurtenant Structures

Visual observations indicated no stability or stress problems in any of the concrete structures. Possible seepage through one of the joints in the ogee section should be observed for possible frost damage.

b. Design and Construction Data

1. Embankment

There was no design criteria for embankment stability in the PennDER files. The subsurface investigation indicates good foundation and acceptable materials for the embankment. The final design drawings indicate a zoning and filter system which is considered adequate. However, there is no drainage system on the downstream slope above elevation 458.3 (Appendix D, Plate IX). In view of the imperviousness of the material and the rock, plus the relative short duration of high water in the impounded lake, the dam is considered satisfactory.

2. Appurtenant Structures

A review of the design drawings indicate that all structures are founded on rock. The type of construction and the size of footings are considered adequate and based on good engineering practice. Due to the nature of the chute (exposed rock) there will be erosion of the fractured rock and a constant maintenance program is required.

c. Operating Records

The facilities have withstood the floods caused by the tropical storms Agnes (1972) and Eloise (1975). The only problem occurred during Agnes, when some damage occurred in the spillway chute.

d. Post Construction Changes

The only post construction modifications occurred in 1973, when repairs were made to the spillway chute.

e. Seismic Stability

The dam is located in Zone 1 and it is considered that the static stability of the dam and structures is sufficient to withstand minor earthquake-induced dynamic forces. No studies or calculations have been made to confirm this assumption.

SECTION 7 - ASSESSMENT AND RECOMMENDATIONS

7.1 DAM ASSESSMENT

a. Safety

The visual inspection, the review of design drawings and the operational history indicate that the dam is in good condition and functioning properly. The hydraulic calculations made in this report indicate that the spillway will not pass the PMF, but will pass 57 percent of PMF. Therefore, the spillway is not seriously inadequate.

b. Adequacy of Information

The information available is considered to be sufficient to make a reasonable assessment of this project.

c. Urgency

Although none of the recommendations made in this report are of an urgent nature, it is considered important to implement these suggestions as soon as practical.

d. Necessity for Additional Studies

The need for additional studies of these facilities is not indicated at this time; however, attention should be given to the recommendations presented below.

7.2 RECOMMENDATIONS

a. Facilities

In order to assure a continued satisfactory operation of this dam, and to be prepared for emergencies, the following is recommended:

1. The owner should investigate the cause of difficult operation of the valve in the control tower and correct the situation.

2. The owner should install a pool-stage staff gage.

b. Operation and Maintenance Procedure

Although the dam and facilities are maintained in good condition, is is considered important that the following procedures be adopted:

1. A formal surveillance and downstream warning system should be developed to be used during periods of high precipitation.

2. A regular inspection program should be developed to inspect possible damage to the spillway chute after high discharges, particularly in the area adjacent to the right spillway chute wall.

3. The stilling basin should be cleared at regular intervals.

4. The left wingwall of the stilling basin should be protected against further erosion.

APPENDIX A

VISUAL CHECKLIST

CHECK LIST - DAM INSPECTION PROGRAM

PHASE I - VISUAL INSPECTION REPORT

NAD NO. 335

PA. ID # 67-486 NAME OF DAM Pinchot Lake Dam HAZARD CATEGORY Signific

TYPE OF DAM: Earthfill - Rockfill

LOCATION: Warrington TOWNSHIP York COUNTY, PENNSYLVANI

INSPECTION DATE 4/12/78 WEATHER Sunny - Windy TEMPERATURE 40's

INSPECTORS: H. Jongsma - R. Houseal — DER Representatives

R. Steacy, - A. Bartlett — Clarke Harris
Norman Templin
Paul Gardosik

NORMAL POOL ELEVATION: 470.0 AT TIME OF INSPECTION:

BREAST ELEVATION: 481.0 POOL ELEVATION: 470.3

SPILLWAY ELEVATION: 472.0 TAILWATER ELEVATION:

MAXIMUM RECORDED POOL ELEVATION: 476 ±

GENERAL COMMENTS:

Located on Beaver Creek.
Light weed growth on downstream side of embankment.
Slopes not mowed.
Channel below outlet - stone lined slopes to grade.
General appearance is rustic.
Maintenance, being a State Park for recreation purposes, concentrates on beaches, boat docks, picnic areas, etc.
Water levels are regulated to preserve these areas.
Dam appears to be in good physical condition.

VISUAL INSPECTION

EMBANKMENT	OBSERVATIONS	REMARKS & RECOMMENDATION
A. SURFACE CRACKS	None apparent	
B. UNUSUAL MOVEMENT BEYOND TOE	None Apparent	
C. SLOUGHING OR EROSION OF EMBANKMENT OR ABUTMENT SLOPES	None Apparent Occasional bare spot on slopes above terrace	
D. VERTICAL & HORIZONTAL ALIGNMENT OF CREST	None Apparent	
E. RIPRAP FAILURES	None - exposed outer zone of rock on slope, slight brush growth	
F. JUNCTION EMBANKMENT & ABUTMENT OR SPILLWAY	No distress	
G. SEEPAGE	Wet areas on terrace - probably due to poor surface drainage. Drain toward spillway	Needs regrading
H. DRAINS	Seem to be working	
J. GAGES & RECORDER	Gaging Station U.S.G.S. near spillway	
K. COVER(GROWTH)	Downstream - grass Upstream - stone Light brush	

VISUAL INSPECTION

OUTLET WORKS	OBSERVATIONS	REMARKS & RECOMMENDATIONS
A. INTAKE STRUCTURE	Good condition. Lid is kept open for airing Cheater required to open gate	
B. OUTLET STRUCTURE	Channel Slopes Dumped Rock Concrete Baffle Stilling Basin Sill	
C. OUTLET CHANNEL	Trash Boon (timber ahead of spillway)	
D. GATES	Maintained - Spring & Fall Cracked - Open 6-8 times a year	
E. EMERGENCY GATE	None	
F. OPERATION & CONTROL	Control for beaches and docking areas	
G. BRIDGE (ACCESS)	None	

VISUAL INSPECTION

SPILLWAY	OBSERVATIONS	REMARKS & RECOMMENDATIONS
A. APPROACH CHANNEL	In rock cut	
B. WEIR: Crest Condition Cracks Deterioration Foundation Abutments	 Good None Nil Good	 At one point some seepa through weir - could c frost damage
C. DISCHARGE CHANNEL Lining Cracks Spilling Basin	In rock excavation non uniform surface Cleaned in August	Stone lined below stilli basin
D. BRIDGE & PIERS	None	
E. GATES & OPERATION EQUIPMENT	Opened spring and fall by operational plan + maybe 6 to 8 times per year. Used to pass storm waters also	
F. CONTROL & HISTORY	Gate used frequently to maintain beaches and boat docks - not too effective	

VISUAL INSPECTION

MISCELLANEOUS	OBSERVATIONS	REMARKS & RECOMMENDATIONS
INSTRUMENTATION		
Monumentation	None	
Observation Wells	None	
Weirs	None	
Piezometers	None	
Other	Gage - U.S.G.S.	
RESERVOIR		
Slopes	Good condition 4 Beaches	
Sedimentation	Some at upper reach of lake.	
DOWNSTREAM CHANNEL		
Condition	Good condition - open No debris Roadway bridge crossing several hundred yards downstream of stilling basin	
Slopes	Grass - light trees	
Approximate Population	Two	
No. Homes	One	

APPENDIX B

HYDROLOGY/HYDRAULICS

SUBJECT

COMPUTED BY RES DATE 4-11-78 CHECKED BY JJPJr 4-19-78

Diversion tunnel low pool outlet

Upstream portal invert 433.0'
Diameter of pipe 3.0'
Pool elevation 436.0'

Downstream portal invert 427'
Radius of pipe 1.5'
q. of pipe 428.5'

Loss in head 436.0 − 428.5 = 7.5 ft.

$S = 7.5/368' = 0.020'$

$V = \frac{0.590}{n} \cdot d^{2/3} \cdot S^{1/2}$ $n = 0.017$; $d = 3.0$, $S = 0.02$

$V = \frac{0.590}{0.017} \times (3.0)^{2/3} \times (0.020)^{1/2} = 34.7 \times 2.08 \times 0.141'$

$V = 10.18$ ft/sec $A = \pi R^2 = \pi \times (1.5)^2 = 7.07'$

$Q = VA = 10.18 \times 7.07'$

$= 72$ cfs

Diversion tunnel outlet at pool elevation 470.0 (crest in notch).

Loss in head = 470.0 − 428.5 = 41.5'

Estimate loss in outlet basin 6.0
Estimate loss in pipe 40.5'

$S = \frac{40.5}{368} = 0.110$ ft/ft.

$V = \frac{0.590}{n} \times d^{2/3} \times S^{1/2}$ $n = 0.017$, $d = 3.0$, $S = 0.11$

$V = \frac{0.590}{0.017} \times (3)^{2/3} \times (0.110)^{1/2}$

$= 34.7 \times 2.08 \times 0.332'$

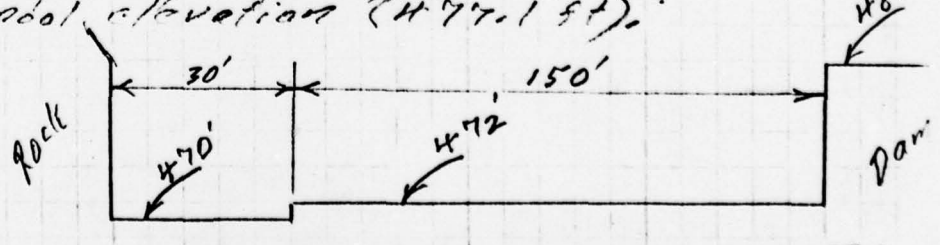
$= 24.0$ ft/sec. $A = \pi R^2 = \pi \times 2.25 = 7.07'$

$Q = VA = 24.0 \times 7.07$

$= 170$ cfs

("No inflow" drawdown curve from owner figures out to 228 cfs - Use 170)

Ungated spillway capacity at maximum pool elevation (477.1 ft).



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SUBJECT

COMPUTED BY RES DATE 4-13-78 CHECKED BY JJPJr 4-19-78

Ungated spillway cont.

Notch portion $Q = CLH^{3/2}$

$H = 477.1 - 470.0 = 7.1'$ $C = 3.8'$, $L = 30'$

$Q = 3.8 \times 30 \times (7.1)^{3/2} =$ 2157 cfs

Remainder

$Q = CLH^{3/2}$ $C = 3.8$, $L = 150'$, $H = 5.1'$

$= 3.8 \times 150 \times (5.1)^{3/2} =$ 6565 cfs

Total entire spillway 8722 cfs

The original design listed 7,600 cfs for this pool elevation. Design calculations are not available. A "C" of 3.8 seems reasonable for this ogee crest.

Maximum known flood at dam site was the Agnes flood of 6-22-72, Peak pool elevation was 476.04. (From USGS pool-stage recorder)

$Q_{notch} = CLH^{3/2}$, $C = 3.8$, $L = 30$, $H = 6.04$

$= 3.8 \times 30 \times (6.04)^{3/2} =$ 1692 cfs

$Q_{remainder} = CLH^{3/2}$, $C = 3.8$, $L = 150$, $H = 4.04$

$= 3.8 \times 150 \times (4.04)^{3/2} =$ 4629 cfs

Total Q, entire spillway 6,320 cfs

Ungated spillway capacity at pool elevation 481.0 ft (Top of Dam)

Notch portion $Q = CLH^{3/2}$ $C = 3.9$, $L = 30$ ft, $H = 481 - 470 = 11$ ft

$Q = 3.9 \times 30 \times (11)^{3/2}$

$= 4,268$ cfs

Remainder $Q = CLH^{3/2}$ $C = 3.9$, $L = 150$, $H = 481 - 472 = 9$

$Q = 3.9 \times 150 \times (9)^{3/2}$

$= 15,795$

Total $Q = 4,268 + 15,795 = 20,100$ cfs

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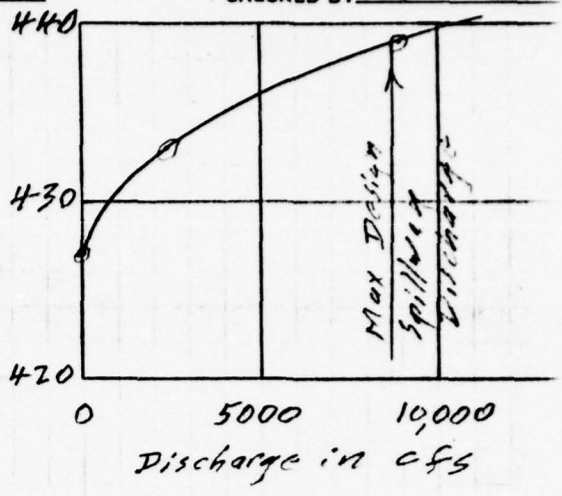
SUBJECT

COMPUTED BY RES DATE 11-[illegible]-78 CHECKED BY JPJr 4-19-78

Maximum tailwater.

Graph at right showing estimated tailwater elevation vs. discharge is based on field inspection of downstream channel. New highway bridge 700 ft downstream has opening 10 ft. × 60 ft. 1972 flood came within 18 inches of underside.



Size Classification
Storage 8,000 Ac.ft. (top of dam)
Height 49 Ft.
Use "Intermediate".

Hazard Potential
Few, if any structures for human habitation and only other structure is highway embankment and bridge 700 ft downstream from dam.
Use "Significant"

Recommended Spillway design Flood
HALF PMF to PMF.
PMF = 2,000 cfs per sq. mi. (From curves supplied by Baltimore Dist. Corps of Eng.)
= 17.5 × 2,000 = 35,000 cfs.
½ PMF = 17,500 cfs.
T = 33 Hours.
100 Yr flood
= Q = cA^K = 434 × (17.5)^.751
= 3,720 cfs (From Table 6A, PADER/USGS Bulletin No. 13 "Floods in Pennsylvania")

Spillway routing for PMF (This storage adj. method furnished by Balt. Dist. Corps of Eng.)
PMF = 35,000 cfs.
Spillway capacity (top of dam) 20,100 cfs

Spillway can pass $\frac{20,100}{35,000}$ = 57 % of PMF

$\frac{\text{Req. Resv. Storage}}{\text{Vol. of Inflow}}$ = .435 (From C of E. graph)

Vol. of Inflow = $\frac{35,000 \times \frac{33}{24}}{2}$ = 24,062 cfs-days
= 24,062 × 1.983471 = 47,730 Ac. ft.

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OBJECT Lincoln Lake Dam - Job # 223

COMPUTED BY KES DATE 4-17-78 CHECKED BY JJP

4-19-78

Spillway routing for PMF (cont.)

Required Resv. Storage = 0.435 × Vol of Inflow

= 0.435 × 47,730

= 20,760 Ac. ft.

Avail storage elev. 470 ft to elev. 481 ft

= 8,000 − 2,800 = 5,200 Ac.-ft.

Dam will be overtopped by PMF.

Spillway routing for ½ PMF

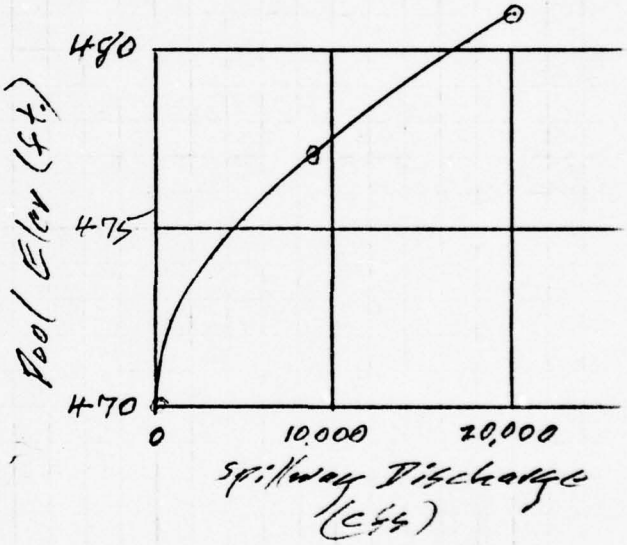
½ PMF = $\frac{35,000}{2}$ = 17,500 cfs

Spillway capacity (top of dam) = 20,100 cfs

17,500 cfs = 480.3 ft on spillway rating.

481.0 − 480.3 = 0.7 ft

Spillway can pass ½ PMF with 0.7 ft freeboard. Neglecting storage



Spillway routing for 100-year flood.

100-year flood = 3,720 cfs

3,720 cfs = 474.8 ft on spillway rating

481.0 − 474.8 = 6.2 ft

Spillway can pass 100-year flood with 6.2 ft freeboard Neglecting storage.

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APPENDIX C

GEOLOGIC REPORT

GEOLOGIC REPORT

Bedrock - Dam

Formation Name: Triassic Diabase.

Lithology: Diabase is an intrusive igneous rock composed essentially of pyroxene and feldspar. Quartz, ilmenite and magnetite are common accessory minerals. The fresh rock is gray to dark gray with massive crystalline texture. Weathered surfaces are dark gray with local brown iron staining. The interlocking crystals of pyroxine and feldspar make the rock very strong.

Bedrock - Reservoir.

Formation Name: Gettysburg Formation and Triassic Diabase.

Lithology: Most of the reservoir is underlain by the Triassic Diabase described above. On the northwest side of the reservoir, and crossing it at the southwest end, is a thin strip of Gettysburg Formation, which separates two parts of the sill. The shale, normally a red silty shale, is here, baked by the diabase intrusion black hornfels. This hornfels is a very tough rock and is more resistant to erosion than the diabase, and underlies the hills on both sides of the reservoir. The hornfels is closely jointed and fractured.

Structure

The diabase at the site is part of the Gettysburg Sill. This is a sheet, several hundred to 1,000 feet thick, intruded, in molten form, between layers of shale. The sheet here dips to the northwest at about 25°. As the molten rock cooled and crystallized, it cracked, forming joints essentially perpendicular to the top and bottom of the sill. The joints break the rock mass into polygonal columns.

There are no mapped faults in the vicinity of the dam or reservoir.

Air photo fracture traces are scarce in the diabase area.

Overburden

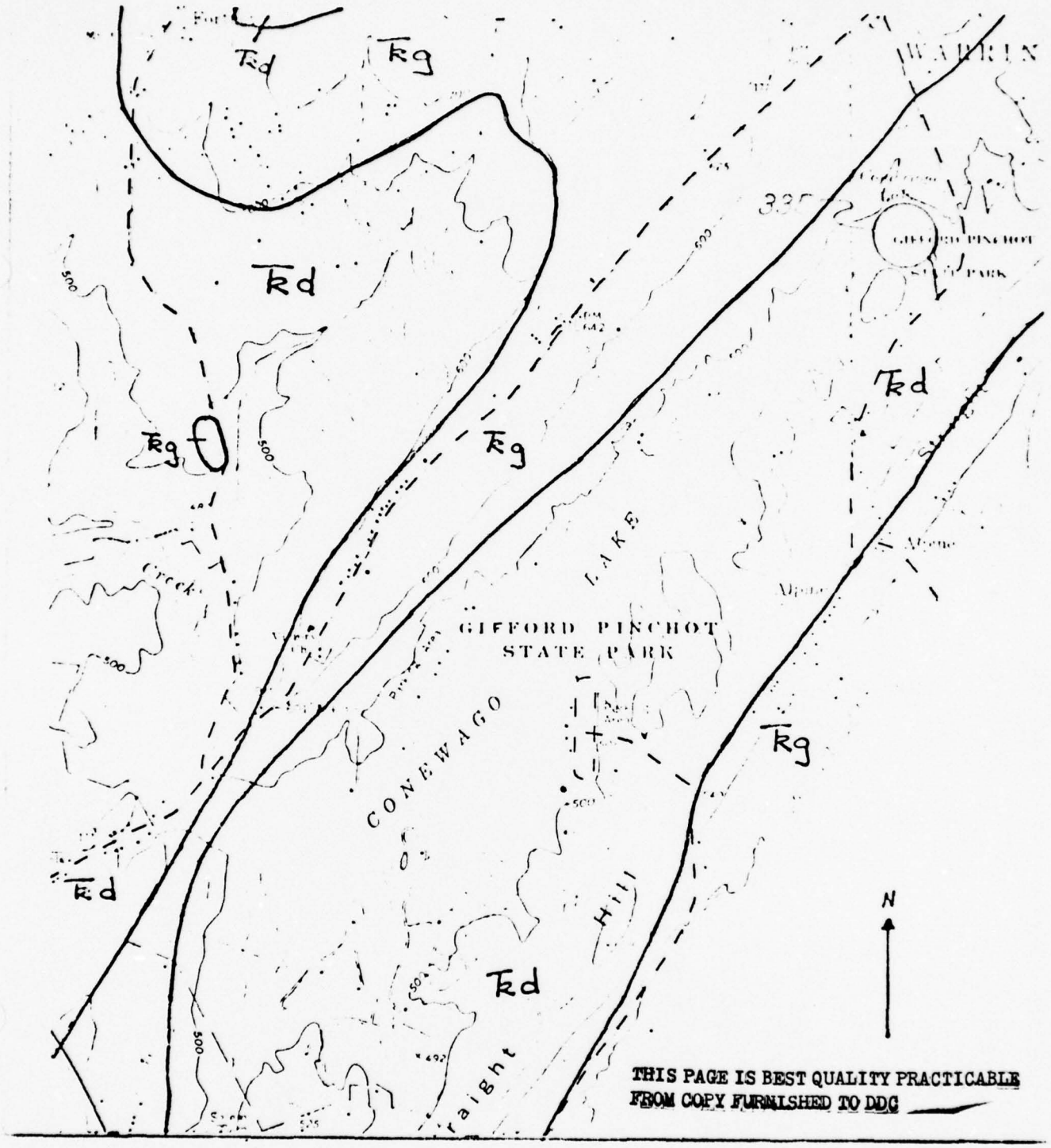
The diabase generally has a relatively thin weathered zone, in which there usually are abundant, rounded boulders of relatively fresh rock. Locally the diabase breaks down to a brown, granular saprolite consisting of clay and iron oxides which often retains the texture of the parent rock. Two of the boreholes indicate this material was as much as 27 feet thick near the center of the dam.

Aquifer Characteristics.

Triassic diabase is a very impermeable rock of very low porosity.

Evaluation

The diabase is an excellent foundation material. The absence of through going fractures makes even small scale leakage through the rock improbable. The hornfels of the Gettysburg Formation is probably more permeable, but it does not occur at the dam.



(from geologic map of York County, Pa., by Stose and Jonas, 1939.)

KEY

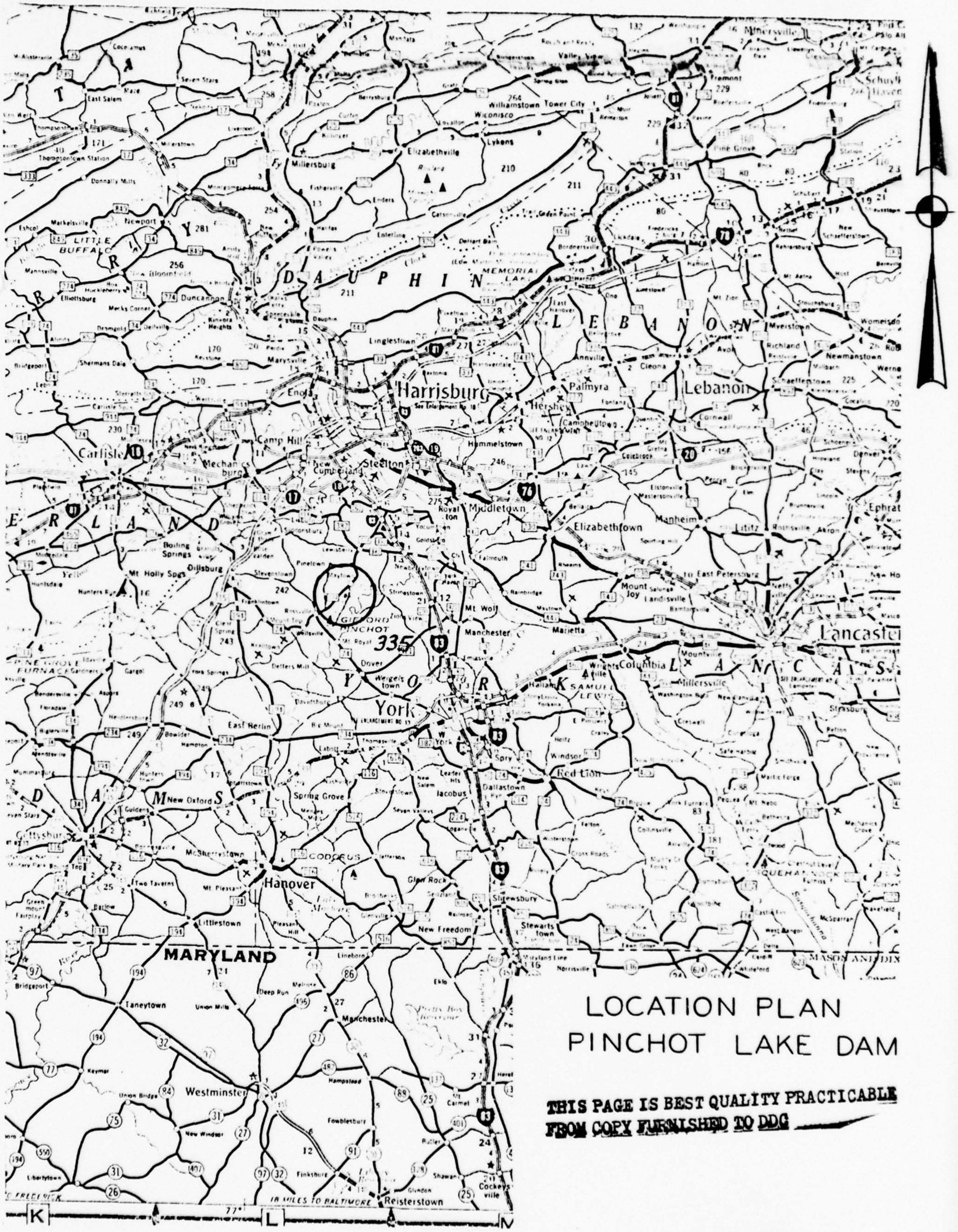
Trd Triassic diabase

Tkg Gettysburg shale

SCALE 1:24000

APPENDIX D

LOCATION, PHOTOGRAPHS & DESIGN DRAWINGS



LOCATION PLAN
PINCHOT LAKE DAM

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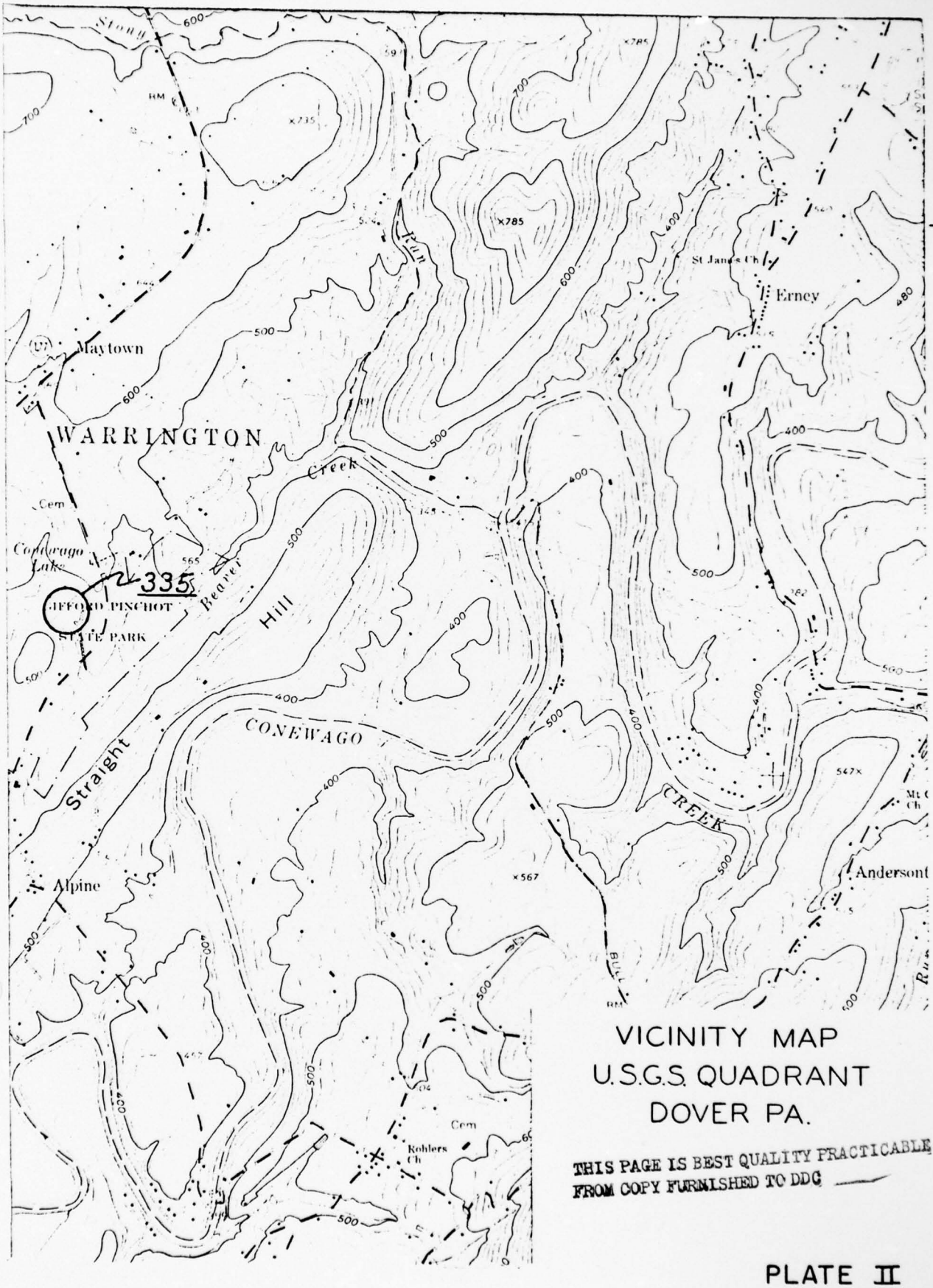
PLATE I



VICINITY MAP
U.S.G.S. QUADRANT
DOVER PA.

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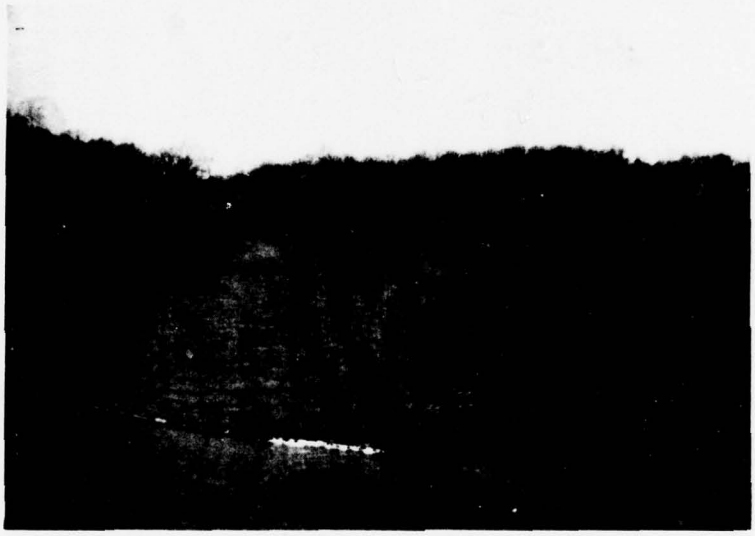
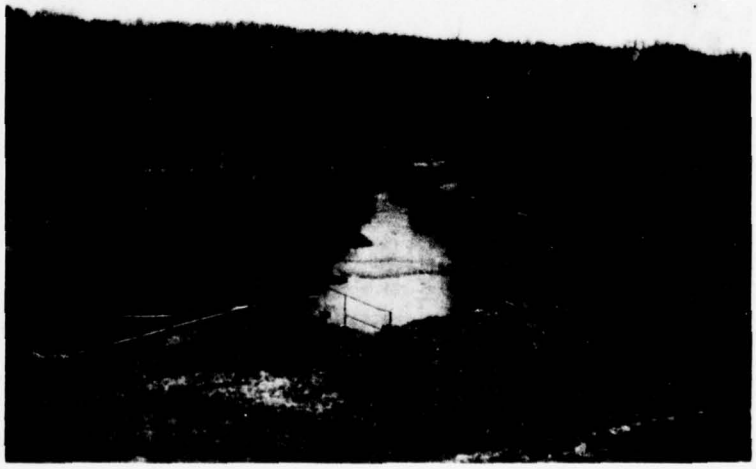
PLATE II

Dam Breast

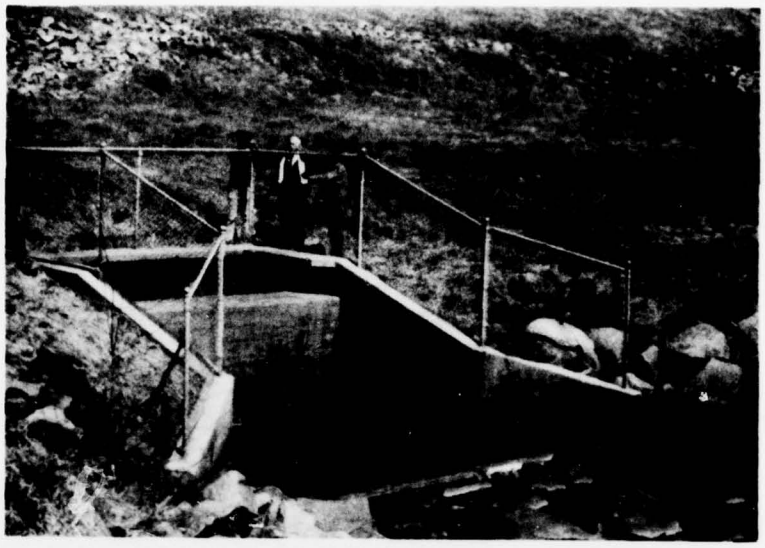


Upstream
Trash Boom

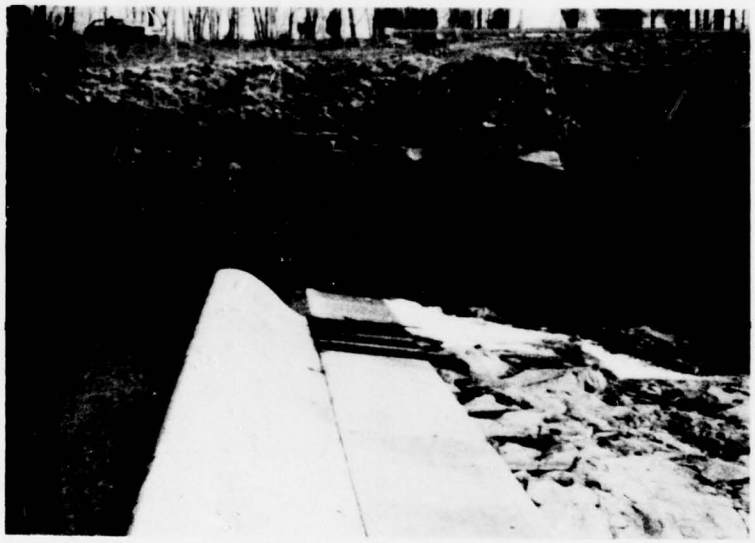


Downstream
Channel

PLATE III



Conduit
Outlet

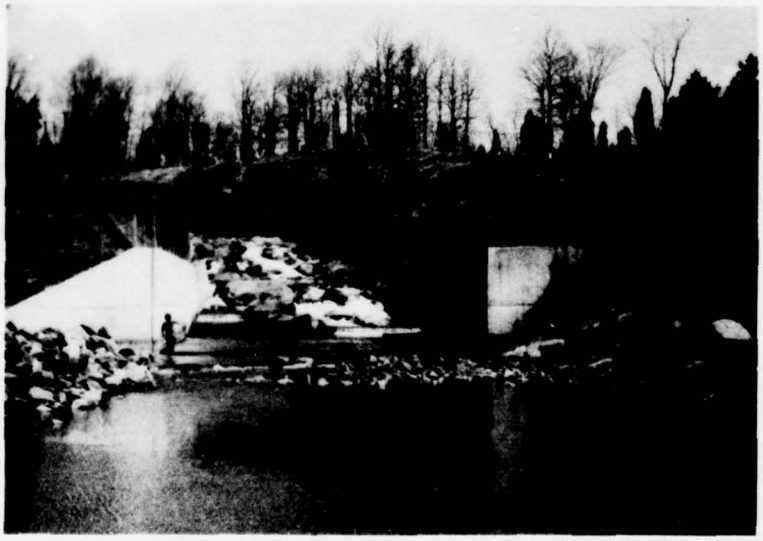


Notched Spillway
Ogee Weir

PLATE IV

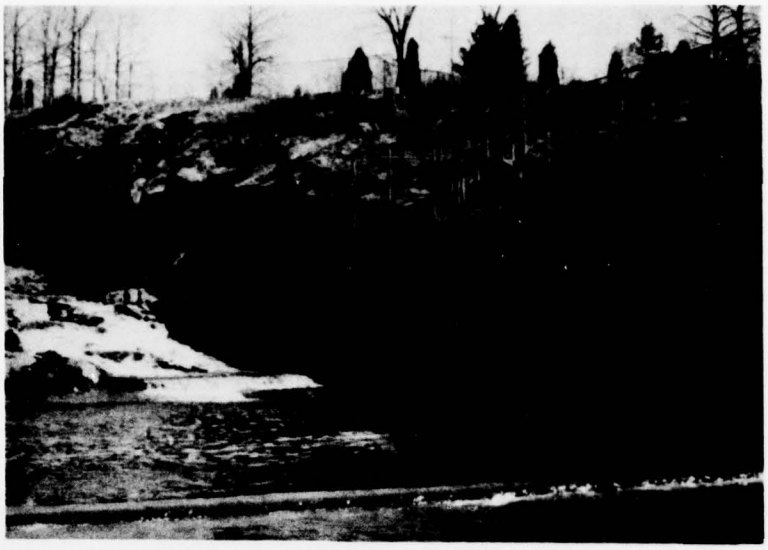
Spillway Chute
Wall Toe
Protection

Spillway Chute



Stilling Basin

PLATE V



Stilling Basin

Left Wall
Stilling Basin

Erosion of
Left Stilling
Basin Wall

PLATE VI

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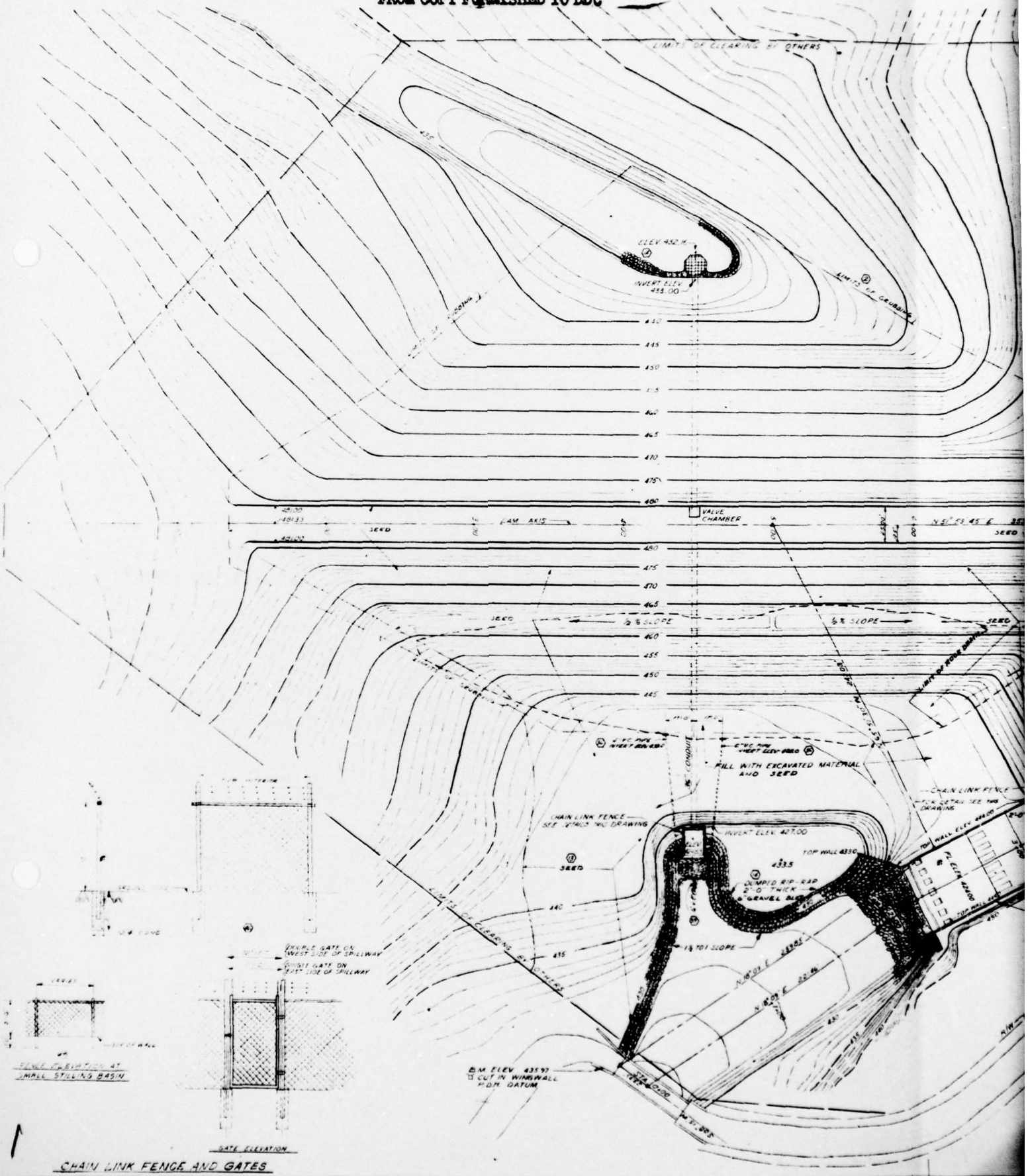

CHAIN LINK FENCE AND GATES

335
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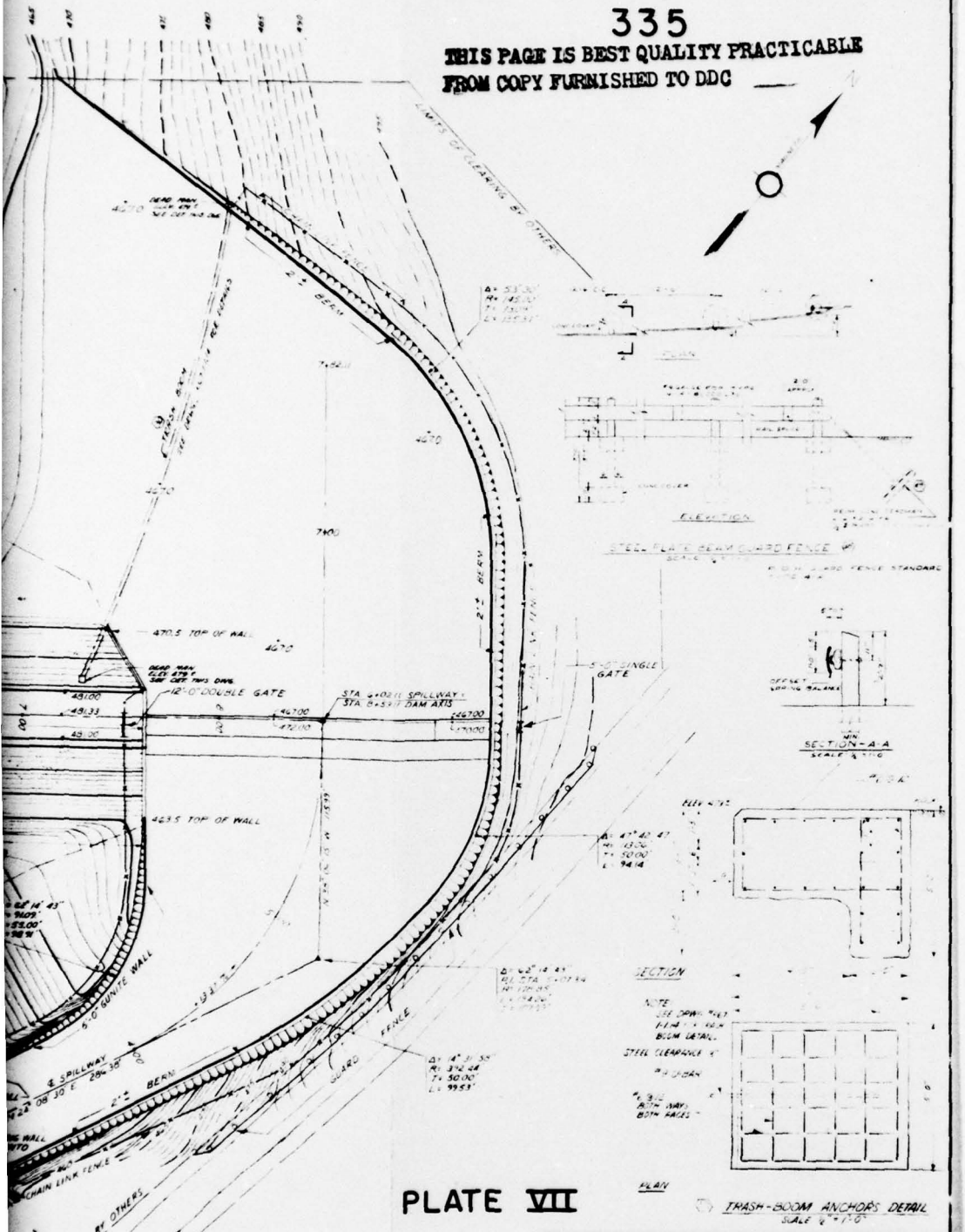


PLATE VII

BUCHART ENGINEERING CORPORATION
CONSULTING ENGINEERS
YORK PENNSYLVANIA

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF FORESTS AND WATERS
DIVISION OF FLOOD CONTROL

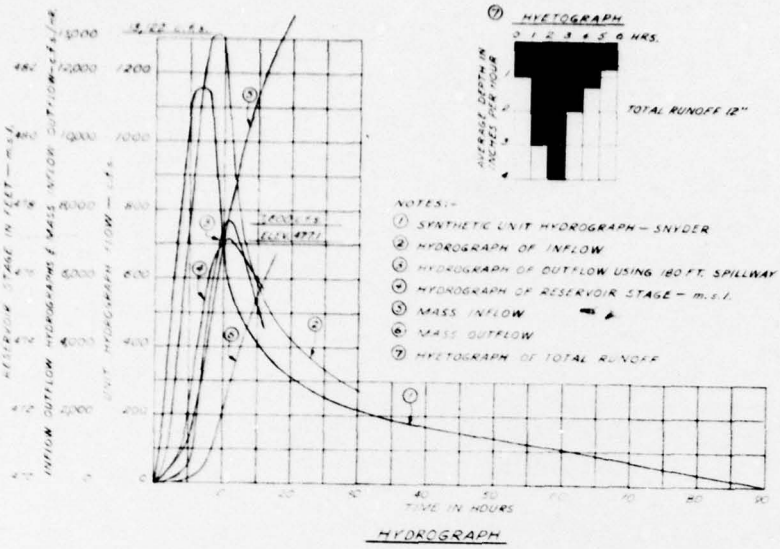
CONEWAGO DAM

GENERAL PLAN
DAM AND SPILLWAY

BEAVER CREEK WARRINGTON TWP
YORK COUNTY, PA.

DESIGNED R.J.B.
DRAWN C.W.
TRACED C.W.
CHECKED H.O.W.

SUBM Clarence Cornell CHIEF, FLOOD CONTROL DIV DATE 5/14/58
RECOM R.R. Murphy CHIEF ENGINEER

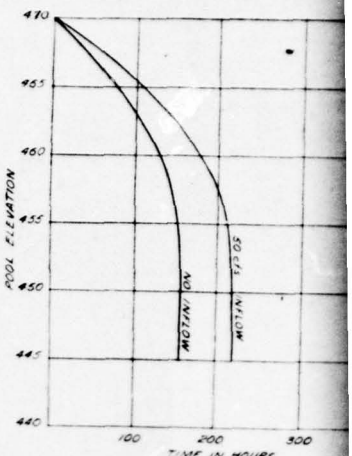


HYDROGRAPH

⑦ HYETOGRAPH

NOTES:-

① SYNTHETIC UNIT HYDROGRAPH — SNYDER
② HYDROGRAPH OF INFLOW
③ HYDROGRAPH OF OUTFLOW USING 180 FT. SPILLWAY WITH 30 FT. NOTCH
④ HYDROGRAPH OF RESERVOIR STAGE — m.s.l.
⑤ MASS INFLOW
⑥ MASS OUTFLOW
⑦ HYETOGRAPH OF TOTAL RUNOFF



DRAWDOWN CURVES

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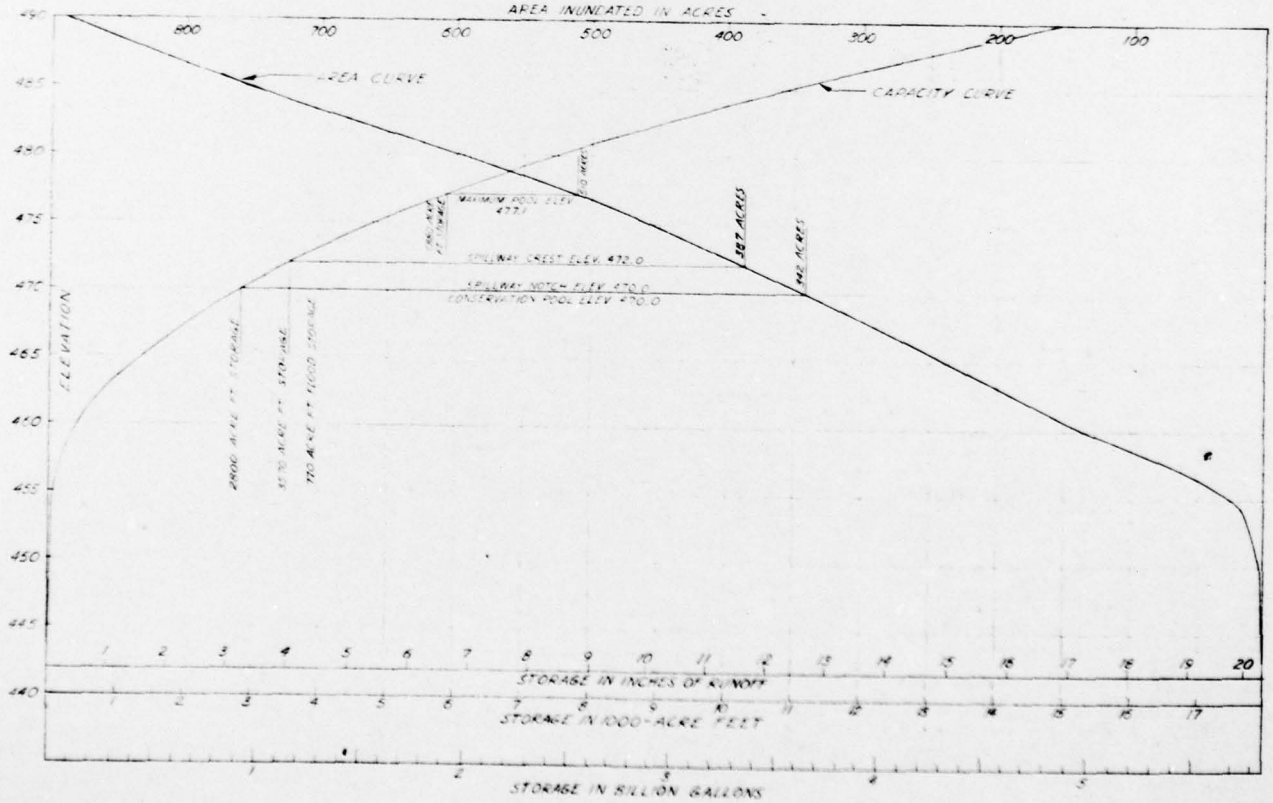
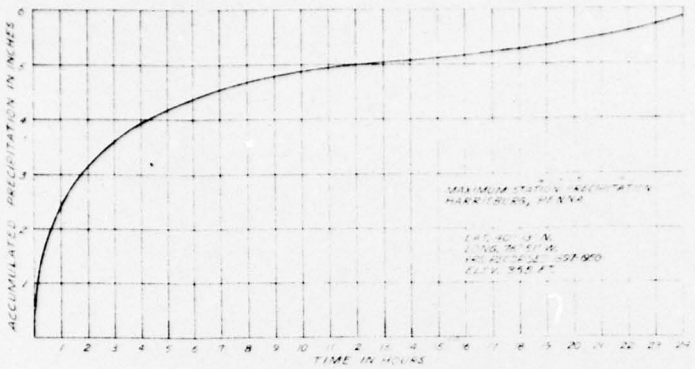


AREA-CAPACITY CURVE



SYNTHETIC MASS RAINFALL CURVE

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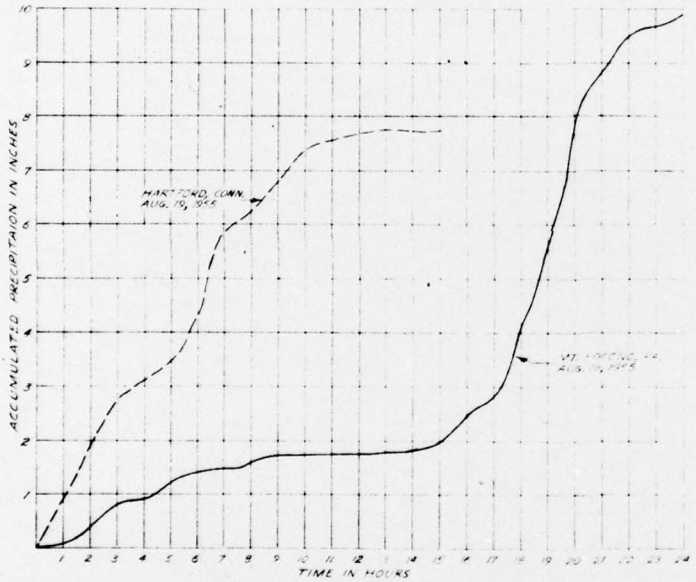


MASS RAINFALL CURVES

PLATE VIII

BUCHART ENGINEERING CORPORATION
CONSULTING ENGINEERS
YORK PENNSYLVANIA

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF FORESTS AND WATERS
DIVISION OF FLOOD CONTROL

CONEWAGO DAM

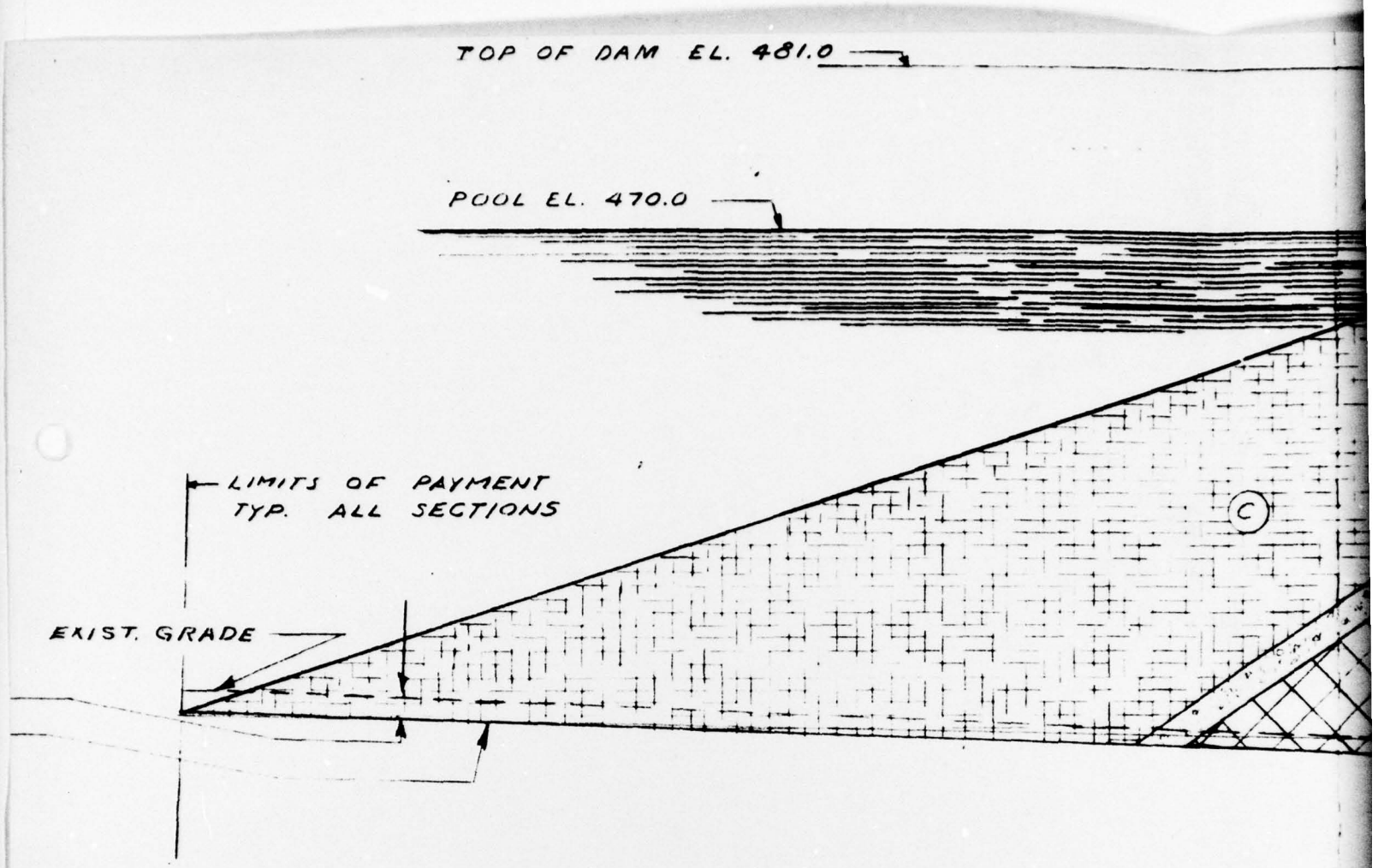
DESIGN CURVES

BEAVER CREEK WARRINGTON TWP.
YORK COUNTY, PA.

DESIGNED R.J.R.
DRAWN E.T.
TRACED E.T.
CHECKED R.J.R.

SUBM _____ CHIEF, FLOOD CONTROL DIV DATE 3/14/58
RECOM _____ CHIEF ENGINEER
APPD _____ SECRETARY

NO	DATE	REVISION	REV	CHK	APPR



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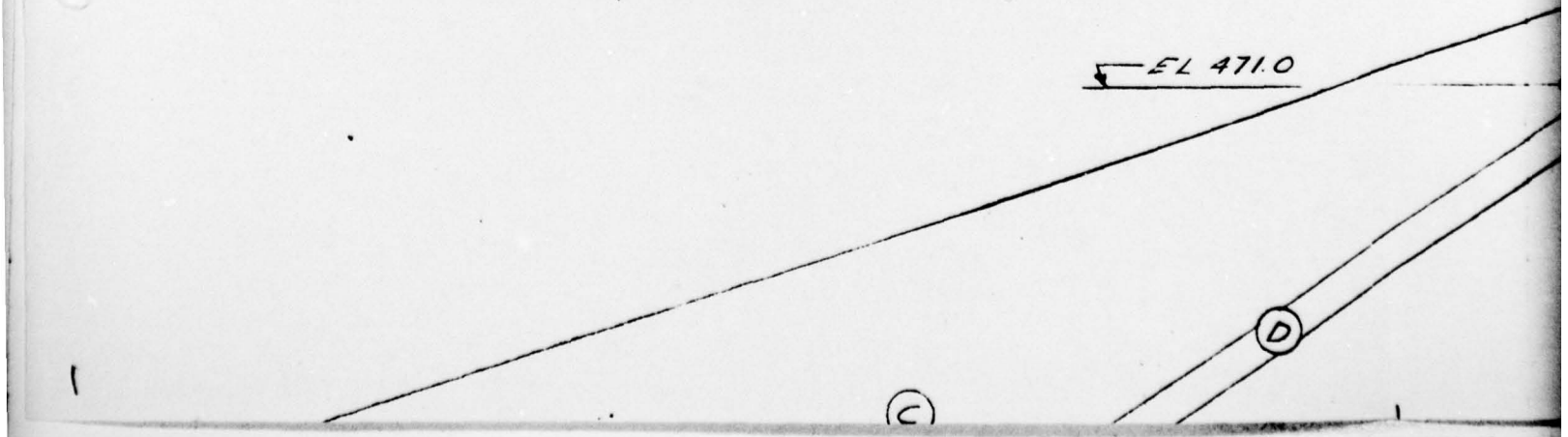

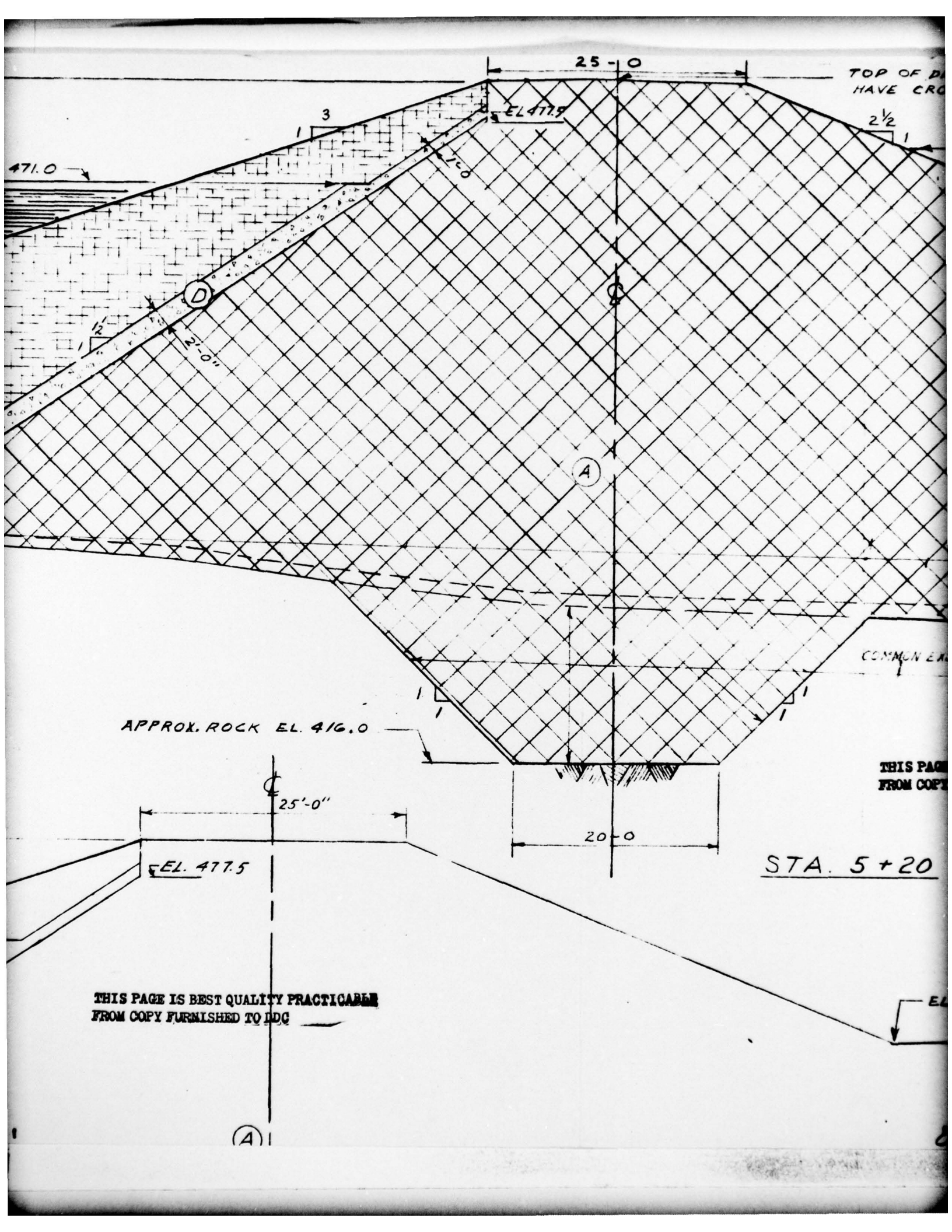
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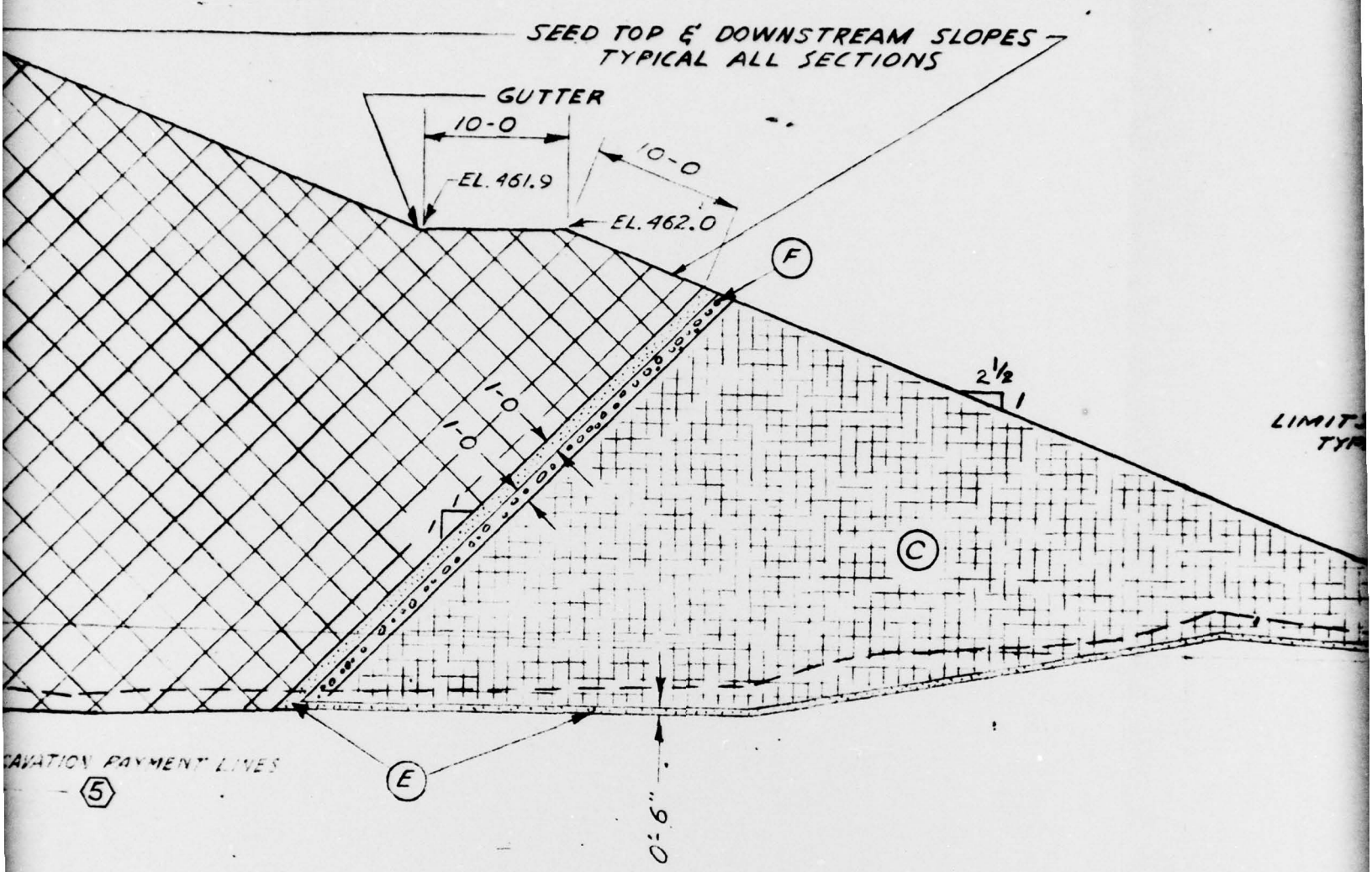

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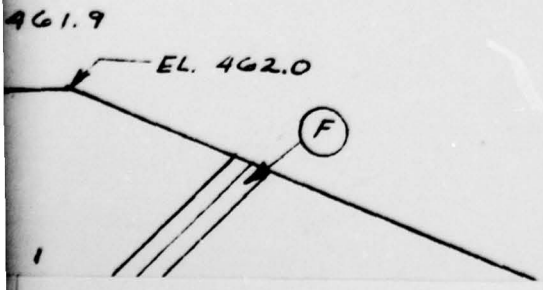
L E

A — IMPERVIOUS MAT
& GRAVEL - ROLL



C — ROCK FILL (5)

D — MIXED FILTER

E — SAND FILTER

F — GRAVEL (NO. 2

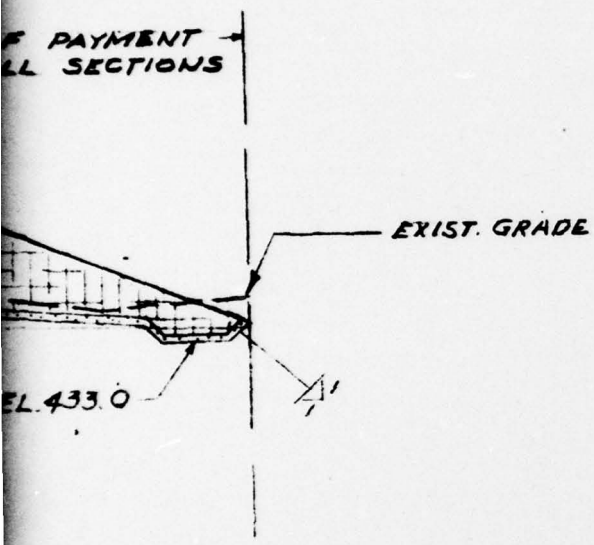
(1½) — INDICATES PAY

480

470

460

450



440

430

420

410

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G E N D

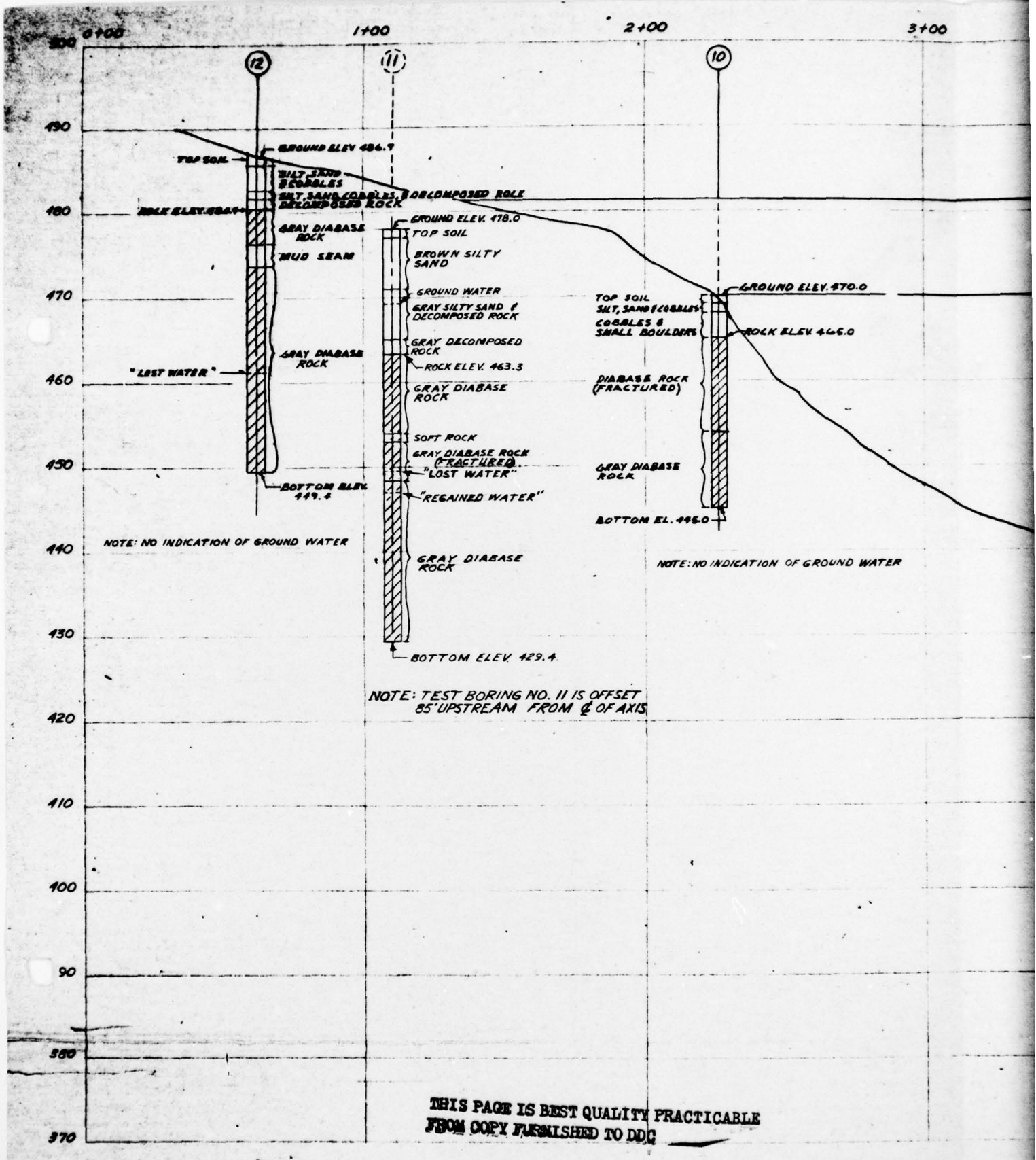
IAL OF SELECTED CLAY, OR CLAY, SAND (8)
INTO COMPACTED LAYERS. (SEE DWG. NO. R67-1-1.3 FOR BORROW A.

EPTH = 2'-0" OR 1'-0" (17)

(15)

ARSE AGGREGATE) (16)

PLATE IX



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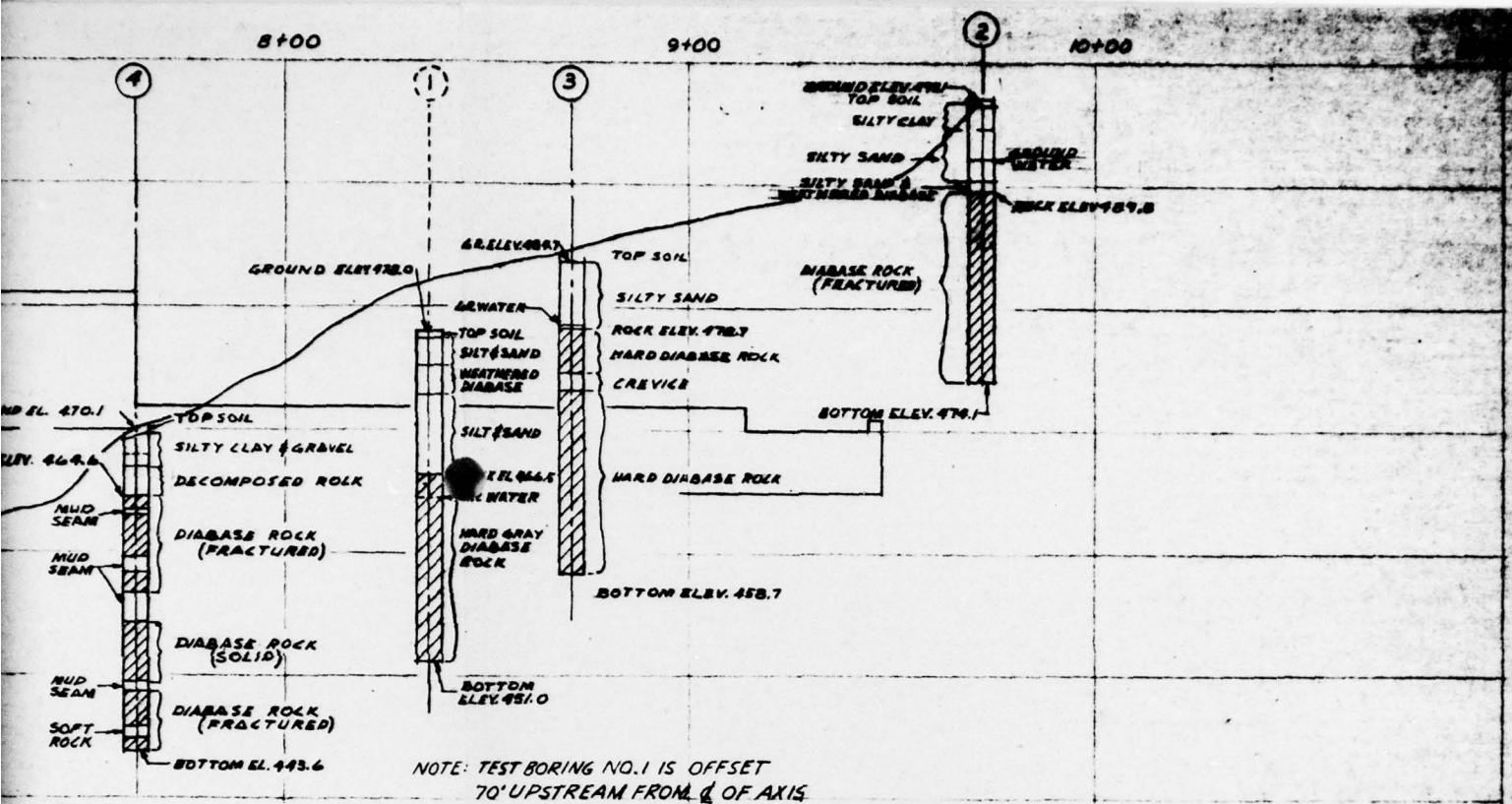
PROFILE ON ℄ OF AXIS
INDICATING TEST BORINGS

GROUT HOLES



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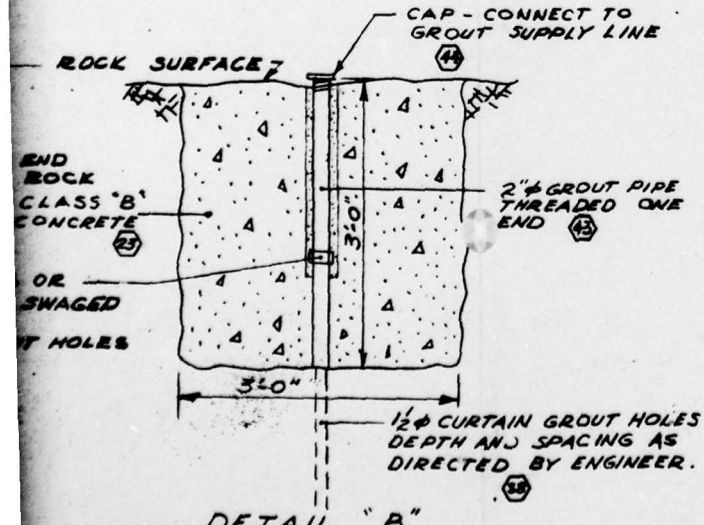

AND GROUT CAP

NOTES:

THE ORDER OF DRILLING, DEPTH OF HOLES, AND FINAL SPACING ... DETERMINED IN THE FIELD BY THE ENGINEER, HOWEVER, ... SHALL ALWAYS PROCEED UPHILL.

DRILLING AND GROUTING SHALL BE DONE THRU 2"ϕ PIPE ... OR THRU CONCRETE CAP WHERE REQUIRED, AS DIRECTED ...

GROUT HOLES TO BE 1½" DIAMETER (EX). DRILLING AND ... SHALL BE DONE BY STAGE METHODS IN ACCORDANCE ... SPECIFICATIONS AND DIRECTIONS OF THE ENGINEER ...

(No.) — INDICATES PAY ITEM

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PLATE X